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## Examining the Utilisation of Mobile Handheld Devices at an Australian Aged Care Facility

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### Abstract

*The Australian health care system is under increasing pressure to enhance the efficiency, effectiveness and range of the services it provides to increasing numbers of people at a time when available resources are limited. As a result the Australian government has identified the increased use of information and communication technologies (ICTs) as a major solution to address these issues and has initiated programs to support their deployment. By providing increased information access, cost effectiveness and improved information delivery, update and evaluation, the economic case for more ICTs is strong. However, this deployment also raises a number of technical, organisational and end-user challenges.*

*With an ageing population, the aged care sector is now in the front-line of these pressures and is facing a situation where spiralling care costs are compounded by a shortage of suitably qualified staff and a demand for services that far outstrips supply. At present the sector is predominantly paper-based with its revenue generation directly linked to the quantity and quality of the documentation it provides to the government on care delivered by facilities to their residents.*

*In this context, this paper reports on the implementation and evaluation of a wireless handheld clinical care management system at an Aged Care Facility in Launceston Tasmania. This socio-technical trial involved collaboration between researchers from the Smart Internet CRC, Telstra Broadband Laboratories, Cpact Pty ltd (a care management software provider) and Carer staff at an Aged Care facility in Launceston. This trial involved the use handheld computers connected to an 802.11 wireless network itself linked to an ADSL broadband connection and Oracle server. This paper reports on the implementation and evaluates the usefulness of this wireless system in the aged care sector. The evaluation was conducted through the use of qualitative techniques and analyses the impact of this wireless system at a technical level, an organisational level and end user level.*

*Preliminary findings indicate at a technical level handheld devices are robust and can be used clinically within a health care environment, at an organisational level handhelds can assist health professionals to conduct their professional services. At an end-user level the ability to improve the accuracy, quality and quantity of documentation is a significant factor, which potentially leads to more time spent with patients.*

**Keywords:** Handheld Computers, PDA, Mobile Technology, Information Systems

## 1. Introduction

The adoption of handheld technology in health care is sustaining positive growth and interest amongst institutions, physicians and nursing staff. Much of the reported literature originates in North America however to date relatively minor research has been reported in Australia. The apt use of technology can bring profound benefits to patients, clinicians and the institutions however inappropriate use of technology can lead to inefficiencies, wasted monies and time (Coiera, 1998). The advent of the Internet and the ability for technology to disseminate clinical information quickly, efficiently internally and externally within healthcare institutions has revolutionarised the health industry (Jadad, 1999). But a smart approach to understanding the interrelationships between communications and information is required (Coiera, 2000).

Traditionally the use of technology in health care has been driven by the institutions pushing technology adoption to end users where the relative success of technology utilisation is questionable. “Over-hyped and often disappointing results have led to a high level of scepticism amongst healthcare practitioners” (Stolworthy & Suszka-Hildebrandt, 2000). More importantly, the culture of the health care industry is an important issue that is sensitive to who is driving the technology (Coiera, 1999).

However emergent research suggests that individuals are readily adopting handheld devices and are finding innovative uses to compliment their existing work practices. With the increasing interest in handheld computing, end-users have been motivated to embrace the technology as opposed to the institutions. In particular it has been reported that physicians and clinical staff lead the uptake of handheld computing devices looking a ways to improve their productivity (Shah, 2001). To a lesser extent nursing staff are also promoting and supporting the use of handheld technology in their work place (Stolworthy and Suszka-Hildebrandt, 2000). As the growth of the mobile handheld technology market increases physicians and nurses are finding real advantages from the use of these devices (Chang *et al*, 2003).

The utilisation of handheld technology can provide a valuable tool for clinicians working in the health domain. This is particularly evident at the point of care where handheld devices are used for;

- up loading and down loading of laboratory results,
- diagnostic tools,
- drug and medical references,
- medical calculators,
- point-of-care testing devices,
- the collection of patient information and
- the provision of clinical guidelines.

The utilisation of handheld computers can be viewed from three distinct views; an end user perspective, an organisational perspective and a technical perspective. Each perceptive provides unique insights into the relative benefits and barriers to the uptake of handheld technology.

From an end-user perspective the ability for mobile technology to perform multiple functions in a hand held device is an attractive proposition (Bird *et al*, 2001). The capacity to

carry multiple clinical reference libraries, drug information and clinical guidelines is an obvious benefit (Enger, 2001; Lapinsky *et al*, 2001; Rosenthal, 2003).

As the diffusion of this technology gains momentum within the health industry there is an increasing amount of specific health care software readily available (Rosenthal, 2003) in some cases for free where applications are often developed by fellow health care professionals (Stolworthy and Suszka-Hildebrandt, 2000). The ability to access and disseminate patient documentation and results at the point-of-care can manifest numerous efficiencies (Coiera, 1996). The nature of the handheld devices and their operating systems facilitates an easy user interface, simple training requirements particularly for end-users that have little or no exposures to conventional desktop computing (Anantraman *et al*, 2002). The transfer of information between handheld devices can be passed effortlessly through the use of wireless infrared communications. This has enabled a simple but efficient “beaming” of nurses notes at the change of their shifts (Enger, J.C. and Segal-Isaacson, 2001; Enger, 2001; Lapinsky *et al*, 2001).

From an organisational perspective the utilisation of handheld computers can offer substantial advantages at the point-of-care, care planning and assessment (Ruland, 2002). The health care industry is one of the most information-intensive of all industries. Handheld computers offer an ideal solution for managing and accessing large volumes of information (Stolworthy and Suszka-Hildebrandt, 2000). Mobile technologies such as handheld devices can potentially increase the speed of care delivery enhancing the effectiveness and efficiency of care provided by having information at hand, facilitating the entry or retrieval of patient centric information in a timely manner at the point of care (Bissell, 2001). This can directly or indirectly lead to greater productivity, accuracy and safety of patients elevating or maintaining a standard level of care (Enger and Segal-Isaacson, 2001). The connectivity of handheld technologies with existing information systems provides a platform to seamlessly share and consolidate information (Lapinsky *et al*, 2001). To realise the full potential of handheld computers as a clinical support tool a holistic attitude of mobile computing implementation is required (Shah, 2001). The integration of handheld devices with established information systems offers great benefit to management, clinicians and ultimately the patient. From an organisational perspective the reported benefits of mobile computing in health care may relate to reduced costs, increased efficiency and improved patient satisfaction.

From a technical perspective the use of handheld technologies offers some unique advantages over conventional computing devices found in the health care domain. The portability of the devices is an attractive proposition when compared to carrying around notebook computers or personal computer tablets. The small size, clear screen and robustness of the handheld device are appealing characteristics (Bird *et al*, 2001; Enger and Segal-Isaacson, 2001; Hansen and Dorup, 2001). The use of pen or stylus interface compliments a user friendly and intuitive operating system that requiring little training and no keyboard skills. In terms of connectivity the handheld devices offer a range of wireless communications methods such as infrared telemetry and Bluetooth. More recently wire and wireless interconnectivity is possible with local area networks using wifi protocols. As the costs of the handheld devices drop the value proposition to owning the mobile technology increases (Anantraman *et al*, 2002).

However with any technology there exists a range of issues or barriers to the adoption or utilisation of the device. The literature suggests a number of points that need to be

considered when contemplating the implementation of handheld computers in the health care domain. Barriers cited in the literature suggest inhibitors to handheld technology adoption include;

- initial set up costs,
- a lack of published reports on the benefits of this technology,
- a lack of information security and privacy
- end user resistance to change and a resentment to the adoption of technology
- an inability to connect / integrate palmtop devices to clinical information systems.
- a slow adoption of technology by physicians
- a lack of sufficient training to instil confidence and understanding amongst users,
- and historically the adoption of IT in a clinical environment will fail dramatically when the motivation is for the technology is for technology sake rather than a solution of clinical problems.

Within Australia there has been limited knowledge focusing on the use of handheld technologies in health care. What is problematic in the literature is a lack of detailed discussion on the useability of handheld computing devices at an end-user, organisational and technical level (Lapinsky *et al*, 2001). Numerous articles have outlined the relative merits of handheld technology within the broader healthcare environment however little research has explored intently the actual impact of the technology on the individuals that ultimately use the devices.

This paper aims to broaden our knowledge and experience by reporting on a trial of handheld devices using clinical assessment software in an aged care facility. The research aims to gain insights into how well the technology assists health care workers at the facility and what benefits, problems and issues emerged for participants involved with the trial. It is hoped that the research identifying the impact of this technology on clinical staff and the organisations can provide some insights for other areas that may be considering the use of handheld computing devices in health care.

### **1.1 Research Question**

What are the benefits, problems and issues that emerged from the trial of handheld computers from an end user, organisational and technical perspective?

### **1.2 The Trial Project**

This project explored the use of mobile wireless handheld technology to improve the resident classification assessment (RCS) process for health care professionals in an aged-care facility. Traditionally the assessment information is recorded on paper-based forms and then transcribed to electronic records when the nurse/carer returns to their workstation. In reality a considerable amount of detail is not recorded in the paper based forms as the documentation is filled out at the end of a nurse's work session some time after the care was actually provided. Statistically only 25% - 45% of the actual care delivered by nurses is currently captured and recorded correctly. The lack of quality documentation to support the RCS directly impacts on the ability for the facility to gain government funding for the services it provides. It is hoped that the clinical software will improve the data collection procedure by using handheld computers to record clinical data at the point of care. This involves entering key information into a series of customised forms located in the handheld devices.

This research aims to explore all aspects of this information system to investigate innovative ways of further improving data capture and exploring techniques for data management, data and application portability, seamless connectivity between wireless and wired platforms. The use of handheld technologies has been well documented in the medical domain but only minor literature has been reported on the use of technology in the aged care sector. The trial aimed to report on the application of wireless Internet connectivity within an aged care facility and the impact mobile handheld technology has on the work roles of the staff and administrators. In particular the study aimed to gain an appreciation of end user experiences with mobile technologies in the clinical environment. The project required collaboration between three stakeholders, technical members of software company providing the clinical system, researchers from the Smart Internet Technology CRC (School of Information Systems, University of Tasmania) and staff from the Telstra's Broadband Laboratories.

## 2. Methodology

The use of an interpretative research approach was considered most appropriate to capture insights about the beliefs, actions, and experiences of carers using the mobile handheld devices in a clinical environment. An interpretivist approach based on an ontology in which reality is subjective, a social product constructed and interpreted by humans as social actors according to their beliefs and value systems (Darke *et al*, 1998). A research strategy employing qualitative research methods was implemented to gather information regarding the use the mobile technology and clinical application. Following a review of literature relating to the use of handheld computers in health care a semi-structured question frame was developed. The review of the literature provided an overview of research on mobile technology adopted by professionals in the health domain however limited insights were found relating to the actual utilisation of mobile handheld computers in the Australian context.

A question frame was developed specifically to gain a greater understanding into the utilisation mobile handheld technology in the aged care sector. The questions were developed to encourage participants to discuss issues relating to the study without imposing limitations or constraints on how the questions may be answered (Doolin, 1996).

The question frame consisted of three sections; useability of the technology, useability of the software and organisational impact. Each section was broken down further into different segments. A brief summary of the question frame is presented in Table 1.0.

**Table 1.0 An Outline of the Question Frame**

<i>Section</i>	<i>Segments</i>
1. Useability of the Hardware	Operation Interface Functionality and Characteristics Problems
2. Useability of the Software	Interface / Navigation Functionality / Features Problems Value derived from the software
3. Organisational Impact	Implementation Integration Problems and Issues

The participants in the trial were selected to gain a broad representation of health professionals providing aged care services in the facility. Carers, enrolled care assistants, registered nurses and administrators were actively involved in the trial and were subsequently interviewed. At the end of each interview the researcher checked through the major points of the interview with each participant. At the completion of the interview a transcript was constructed in preparation for data analysis. If any inconsistencies or ambiguities appeared during the preliminary data analysis the researcher contacted the interviewees to clarify any points of confusion.

A coding procedure was adopted for data analysis drawing upon the principles of grounded theory. The coding practices employed provided a mechanism for data abstraction to reveal both the conceptual complexities in the data. The analytical approach provided an essential device to condense the vast volume of data gathered from each participant and the coding procedures highlighted the conceptual complexity within the data while retaining a high degree of richness and meaning associated with concepts, themes.

### **3. Discussion**

#### **3.1 From a End User Perspective**

The implementation of the mobile handheld technology at the aged care facility was met with enthusiasm. Carers at the facility used three Pocket PC handheld computers to document the level of care provided and to assist with the assessment process. Participants in the trial had varying computer experience however it was the first formal interaction with the handheld technology. Preliminary findings from the analysis of the data suggests the use of handheld computers benefit carers and nursing staff in documentation requirements and the RSC assessments on residents. The most important advantage for using the handheld devices was that the quality and quantity of documentation recorded at the point of care increased significantly. Also it was perceived that the time required to complete the documentation was reduced allowing staff to spend more time with residents.

"It wasn't as time consuming. Documentation is better as you are doing it at the time."

"It helps documentation, been able to document things as they happen. It will save you time so it would be less than three quarters of an hour."

The electronic forms on the handhelds also helped staff, acting as a reminder or prompt to recollect the day to day events.

A key concern for the participants was the inability to easily carry the handheld devices. The use of belt holder and pockets proved cumbersome and problematic especially when carers required the use of both hands to help move, reposition or bathe residents. The cases provided in the trial also offered little or no protection if the devices were dropped or knocked.

"I find this is bulky. I carried around for one morning, Matthew asked me to and I find it heavy and I'm frightened I'll break it. I know it's an expensive piece of equipment. Because with an ECA, as you know our work load it heavy and you are doing a lot of twisting and turning, pulling peoples shoes off and things like that, and I've got to be careful and I've got to know where it is at all times, basically."

Only two carers had used a computer before and those staff who considered themselves computer illiterate found the interaction with the handheld devices daunting to begin with but after a few weeks of use they became quite comfortable with the operation and of the

devices. Participants enjoyed using the pen stylus as a primary interface with the devices however it was noted that the stylus should be tethered to the device so it wouldn't be lost.

"I wouldn't want to use a keyboard. I would prefer a pen to typing."

When asked if other interfaces would be appropriate or preferred such as using a keyboard all participants agreed that the pen interface was optimal. The use of voice input was considered a potential advantage but would need further investigation. The need for structured training and support in the early stages of the trial was paramount and was considered vital to the success of the trial.

The major problem in the trial was establishing wireless connectivity to the 802.11b base stations for user authentication. If the connection was not established or users failed to login correctly many participants become confused or agitated. It is recommended that extra training be provided to guide the user through the login process and what to do if the connection fails. A key recommendation is that the total user experience from turning the device on, logging and starting the application needs to be a turnkey solution.

### **3.2 From an Organisational Perspective**

The trial highlighted that handheld computers can bring about significant advantages in the documentation requirements of care staff. The technology aided in improving the quality and quantity of documentation to meet the RCS assessment requirements. However added benefit could be derived from the technology and software if smart software could be employed to intelligently link all sources of information available about residents to complete the assessment criteria.

"If in that program there was the ability for it to draw alert to information that was going in that wasn't maintaining a standard, and could alert the nurse manager then yes. If I was to go to the site and click on something that said 'Is there anything that I need to be made aware of' and it came up with this person. Then yes. You could really look at something beneficial."

From the experience of the trial, the organisation acknowledges the importance of staff training with new technology. A lack of training directly affects the motivation to adopt and embrace the technology.

"Probably that this organisation really needed to look at removing the people involved in the trial for a whole day. Setting up a whole day, rather than pulling them off shift to do the training. If we were serious about looking at this then we should look at investing time. It would have cost us money to bring them in, but I think that would have to occur."

In the past it has been reported in the literature that inadequate training is a major barrier to technology adoption (Stolworthy & Suszka-Hildebrandt, 2000; Lapinsky *et al*, 2001).

### **3.3 From a Technology Perspective**

The use of the pen interface worked well with no need to use a keyboard or other type of interface to aid in the documentation process. The size of the handheld and the screen resolution was declared adequate however the device does need to be stored easily when both hands are required. It was suggested that the use of voice interaction may have merit in times where the staff can't hold the devices.

"...something you could actually speak into, voice recognition or something, would make life just so much easier. Because your collection of information would be enormous, in comparison."



Battery life on the devices did not present a problem. The major advantage of the handheld devices was that it was available at the point of care offering total mobility around the wards and potentially across facilities.

### **3.4 Reasons for Success**

The implementation of the handheld devices was considered successful by all those involved in the trial. Although the facility did not have to pay for any of the trial equipment the organisation acknowledged significant merit in pursuing the future adoption of this technology after the trial. The management support for the trial and the provision of extensive group and one-on-one training contained any end user resistance to change or possible resentment to the adoption of the technology. The use of handheld computing devices in a clinical setting has been discussed in detail particularly where the devices are used as stand alone devices. A major challenge of this trial was to provide seamless wireless connectivity for the passage of data in real time to servers hosted off site. Although there were instances where staff found it difficult to initially connect to external servers the ongoing training and increased awareness of the technology minimised any further connectivity problems. The realisation of tangible benefits gained by staff involved with the trial contributed directly to the relative success of the trial. The increased efficiency in documentation in terms of quality and quantity justified the use of handheld devices as opposed to implementing the technology for technology sake. The considerable support provided by management to encourage participation in the trial was a major contributing factor for the trial's success.

## **4. Conclusion**

This trial has explored the use of handheld computing in one particular area within the health care domain. The technology was deemed to be beneficial to the end-users and organisation as a whole. Although the handheld devices were primarily used to aid in data collection the potential to provide added benefit is significant. The ability to send and receive clinical information live wirelessly 24/7 provides the building blocks to add extra functionality and an opportunity to derive greater benefit.

The end user acceptance of the devices exemplifies the simple pen based interface and intuitive operating system of the handheld devices. The size was considered convenient but requires more thought about storing the devices on the user. As with any technology implementation the amount of training and available support is paramount to guarantee a significant chance of technology adoption and utilisation. The use of handheld technology is still gaining momentum in the health care sector. All individuals involved with the trial agreed that the use of handheld technology does have a place complimenting and assisting their current health care services.

With respect to other IS implementation projects that may involve the use of mobile handheld technologies. The trial found the support of management and the extensive training provided by the research team were major contributing factors to the relative success of the trial. The encouragement by management to trial the technology combined with the intuitive user interface of the handheld devices helped minimised any barriers to the adoption of this mobile handheld technology.

## **5. Acknowledgments**

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